United States Department of Agriculture | Forest Service | NA - St. Paul

Reply to: 3400 Date: December 22, 1993

Subject: Biological Evaluation of Gypsy Moth Populations on the Huron-Manistee National Forest

To: Forest Supervisor, Huron-Manistee NF

Attached is the 1993-94 Biological Evaluation of gypsy moth populations on the Huron-Manistee National Forest. This document evaluates the 1993 aerial suppression program and makes 1994 gypsy moth population predictions on 64 sites selected by the Ranger Districts. The egg mass counts that are used in the predictions were collected by your field staff in October and November.

Defoliating populations of gypsy moth are now present across the entire Huron-Manistee Forest. This situation will stay with the National Forest for the foreseeable future. It is likely that some tree mortality, especially oak mortality, will occur during the next 5-10 years. In certain locations this could be significant; in other locations it could be minimal.

Of the 64 sites evaluated, 29 exceeded our potential damage threshold. The 29 sites totaled 1,638 acres. These sites are likely to require protection in 1994 to avoid defoliation. Table 4 in the enclosed document lists those specific sites.

We had one major concern dealing with the evaluation of the 1993 aerial treatment program. As detailed in the Biological Evaluation, only 14 of the 36 spray blocks were monitored for defoliation in mid-summer. This makes an evaluation of program success difficult. We would like to evaluate all of the spray sites for foliage protection. In 1994, our office will dedicate one individual to visit the Huron-Manistee and check each treatment site, if you conduct suppression activities in 1994. This was our responsibility in 1993, and we apologize for not getting over and checking the treatment blocks.

We hope you find this evaluation beneficial. If we can be of any further assistance, please contact us. For your information, we plan on mapping 1994 defoliation next summer as we have the past several years.

Dennis A. Hauger for

JAMES B. HANSON
Field Representative
Forest Health Protection

Enclosure

cc:
FHP, NA Radnor
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BIOLOGICAL EVALUATION

OF GYPSY MOTH POPULATIONS ON THE HURON-MANISTEE NATIONAL FOREST

MICHIGAN

1993-1994

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December 1993

USDA FOREST SERVICE

NORTHEASTERN AREA STATE AND PRIVATE FORESTRY

INTRODUCTION

In 1993, visible defoliation from gypsy moth was present on all seven Ranger Districts of the Huron-Manistee National Forest (Figures 1 and 2). Defoliation was estimated at 122,003 acres Forest-wide, with 11,494 acres observed on the Huron Forest and 110,509 acres on the Manistee Forest. This was a reduction in overall acreage from 196,671 acres, forest-wide, in 1992.

In order to evaluate the potential impact from gypsy moth in 1994 on the Huron-Manistee National Forest, the USDA Forest Service, State and Private Forestry, Forest Health Protection (FHP), St. Paul Field Office, was requested to evaluate populations at 64 different locations, including two apple orchards. The purpose of the evaluation was to determine if gypsy moth populations, which are estimated by an egg mass survey, would be great enough to cause significant damage in 1994. Further, the evaluation lists possible management alternatives that are available if damaging gypsy moth populations at a site are predicted.

This document also serves as an evaluation of the 1993 aerial treatment program. In 1993, the Huron-Manistee National Forest conducted aerial gypsy moth suppression activities on 33 sites, totalling 1,925 acres. A further three sites, totaling 79 acres were treated within the State of Michigan's Cooperative Suppression Program. Aerial application of the insecticide Bacillus thuringiensis variety kurstaki (Bt) was used in all cases. The National Forest program used a Bt rate of 20 BIU's per acre. The three sites sprayed under the Cooperative Suppression Program were treated at 16 BIU's per acre.

METHODS

1993 PROGRAM EVALUATION

The measure of success was defined as "defoliation levels at or below 30 percent". During the summer of 1993, National Forest field personnel were asked to estimate defoliation on 1993 treatment areas from the ground. Defoliation estimates were made immediately after gypsy moth feeding was completed for the summer. Defoliation was classed into percentage brackets, i.e. 25 percent defoliation means that 25 percent of the "normal" amount of foliage is missing. Defoliation was estimated in 5 percent increments.

EVALUATIONS OF SITES PROPOSED FOR 1994 TREATMENTS

In October 1993, the National Forest designated specific areas in which they would consider foliage protection as a management option. These areas were designated due to their inherently high value (i.e. recreation areas, wildlife plantings, research sites) or because of their high risk of sustaining tree mortality from gypsy moth defoliation (i.e. recently thinned oak sites, previously defoliated oak stands and old apple orchards). Within each of these areas, egg mass surveys were conducted by National Forest personnel. Numbers of egg masses per acre were estimated utilizing a fixed-radius plot method (1/40th acre). On sites of 80 acres or less, one plot was sampled for every 20 acres, though a minimum of three plots were required for any site. On sites larger than 80 acres in size, a minimum of four plots were required with the addition of an extra plot for each additional 40 acres over 80 acres. On sites

Figure 1.

Huron National Forest
1993 Aerial Survey Results

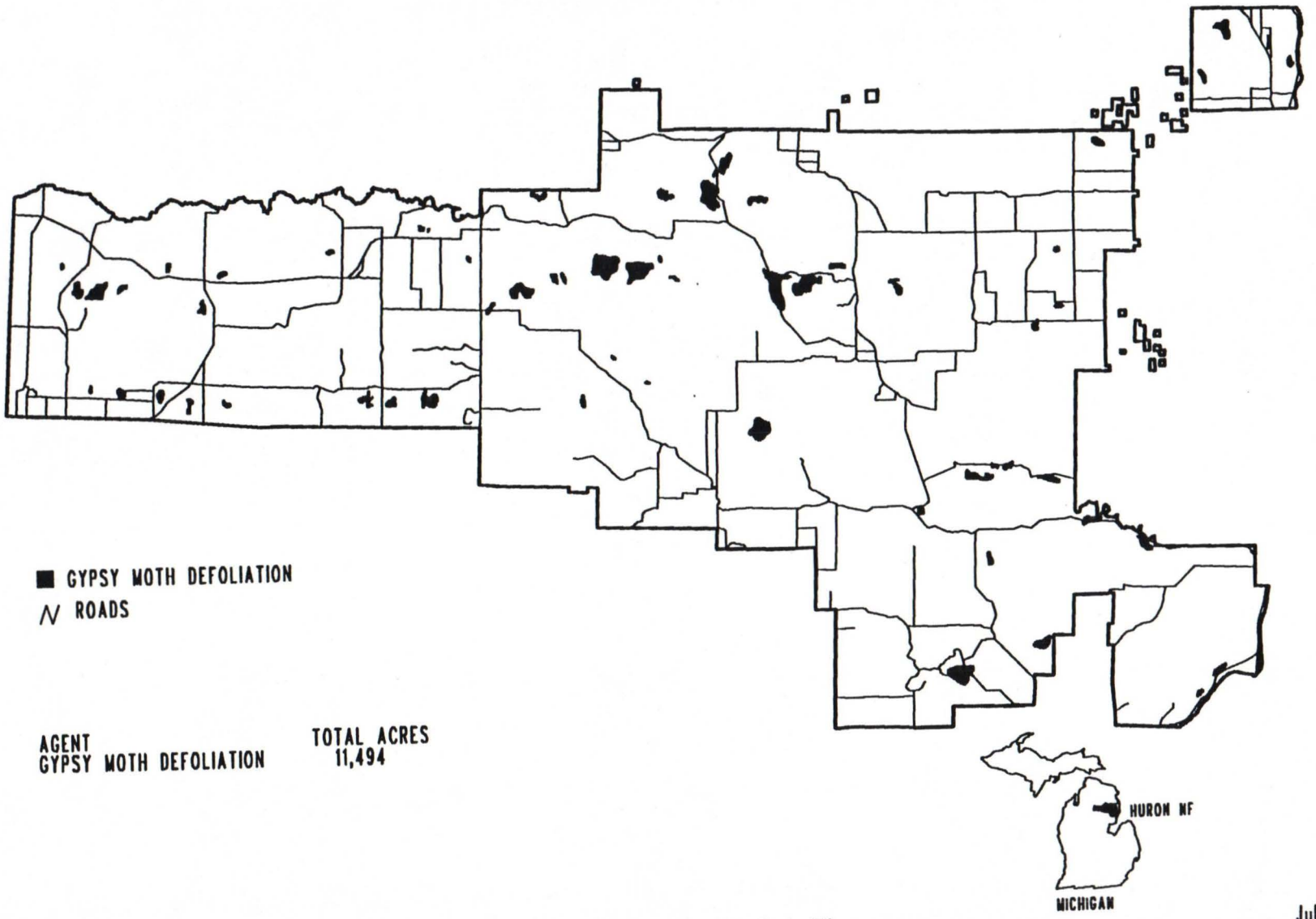

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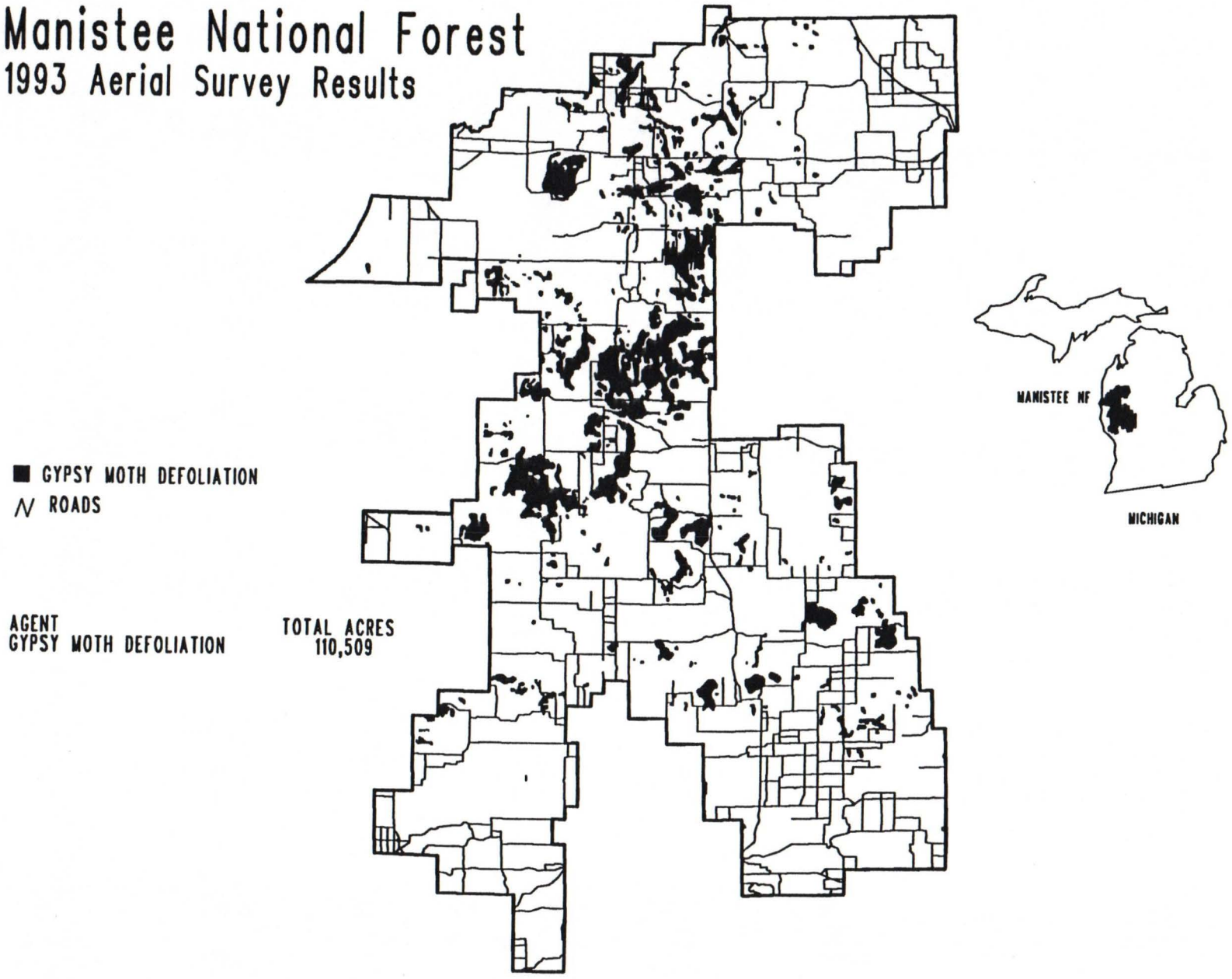
Figure 2.



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July 1993

larger than 240 acres, individual sampling plans were devised by an FHP entomologist. In 1991, the FHP staff spent one day training National Forest crew members on the fixed-radius plot method.

For each site sampled via the fixed-radius plot (1/40th acre) method, the number of egg masses per acre were estimated by averaging the number of egg masses counted per plot and multiplying by 40.

A treatment threshold of 300 egg masses per acre was used in this biological evaluation. Sites with greater than 300 egg masses are designated for further treatment consideration within an environmental assessment process. Sites with less than 300 egg masses per acre are deemed to have predicted caterpillar populations less than damaging to the forest resource and should not cause undue nuisance at recreation sites. The State of Michigan also uses 300 egg masses per acre as a treatment threshold.

Some Ranger Districts sampled several sites for monitoring purposes only, no treatment recommendations were requested. These sites are listed in this document to provide a permanent record.

Apple orchards, with their wide spacing and short compact trees, were deemed different from forest stands. The 300 egg mass per acre threshold is probably too great for orchards. This is because an acre of orchard contains a great deal less foliage for caterpillars to feed on than an acre of woodland. Therefore, egg masses per tree was deemed to be a more useful value and was recorded for orchard sites. This assessment uses 3 egg masses per tree as a minimum for recommending treatment in an orchard setting. A 100 percent survey of egg masses on trees within each orchard was done if the orchard was relatively small (< 5 acres). A subsample of trees was conducted in orchards greater than 5 acres in size.

Data collected at each site included the size of the average egg mass present. Egg masses were listed as the size of a dime, nickel or quarter. The number of eggs within a mass is positively correlated with size. Dime size may indicate a population decline is imminent, whereas quarter size may indicate an apparently healthy, thriving population. Also collected was a ratio of "new" to "old" egg masses. This ratio provides some information on the history of the gypsy moth population level at that particular location. Other information collected included a detailed site map indicating the location of any open water, dwellings, roads, etc.

RESULTS

1993 PROGRAM EVALUATION

Table 1 lists percent defoliation on the treatment blocks following Bt application. Only 14 of the 36 sites treated in 1993 were evaluated for defoliation during mid-summer, 1993. Therefore, we could not determine project success on the majority of the project areas. Using 30 percent defoliation as a cutoff for success, 11 of 14 treatment sites were deemed successful. The three sites not considered successful were listed at 40-45 percent defoliation, not a great failure. Field notes from those three sites indicated that for two of them, Gizzard Chips Timber Sale and Timber Creek Campground, defoliation in areas immediately outside the spray block was estimated at 60 percent.

Table 1. 1993 aerial treatment sites on the Huron-Manistee National Forest, Michigan. Site numbers correspond to Table 2 and the attached maps. Each site is listed by local name (CG indicates campground, CL indicates canoe landing) and legal description. Percent defoliation was estimated visually from ground checks in July 1993. (NA indicates data not collected).

SITE #	AREA NAME (LEGAL DESCRIPTION)	% DEFOLIATION SUMMER 1993
	HURON NF LOCATIONS	
MI2	Luzerne Trail Camp, T25N,R1E,Sec 3	NA
MI1	Island Lake CG, T25N,R2E,Sec 36	NA
T1	S. Branch Trail Camp, T24N,R5E,Sec 11	NA
T2	Rollways CG, T24N,R5E,Sec 24	NA
T5	Iargo Springs, T24N,R6E,Sec 26	NA
T4	Lumberman's Mon., T24N,R7E,Sec 31,32	NA
T3	SidTown, T24N,R7E,Sec 20	NA
T6	Round Lake CG, T22N,R6E,Sec 3	NA
T7	Sand Lake Picnic Area, T23N,R6E,Sec 36	NA
	MANISTEE NF LOCATIONS	
C12	Mission Ch., T22N,R12W,Sec 29,32	NA
C6	Dowling Creek, T21N,R11W,Sec 29	NA
C7	Ravine CG, T21N,R11W,Sec 28	NA
C8	Elm Flats CL, T20N,R12W,Sec 2	NA
C9	Wellston Lab, T21N,R12W,Sec 7	NA
C10	Peterson South, T21N,R12W,Sec 20	NA
C4	TV Tower Oaks, T22N,R12W,Sec 24	NA
C1	Stoddard Lake B, T23N,R10W,Sec 25	NA
C1	Stoddard Lake C, T23N,R10W,Sec 36	NA
B3	US 10 E. Rest Area, T17N,R11W,Sec 1	25
B20	Lower Branch CL, T17N,R15W,Sec 24	10
B10	Elk Canoe CG, T18N,R14W,Sec 30	35
B4	Highbank CG, T16N,R13W,Sec 17,20	10
B5	Old Grade CG, T19N,R13W,Sec 10	15
B17	Timber Creek CG, T18N,R14W,Sec 16	45
B22	Gizzard Chips TS, T18N,R14W,Sec 15	40
B16	Rainbow Rapids CL, T18N,R14W,Sec 27,28	20
B11	Nichols/Walkup Rec, T16N,R13W,Sec 31	30
W5	Benton Lake CG, T15N,R13W,Sec 20,29	10
W16	Gusher TS, T14N,R11W,Sec 23	10
W1	Hungerford Lake, T15N,R11W,Sec 15	10
C11	**Dobson Bridge CL, T21N,R12W,Sec 27,33***	**NA**
MA5	**Sand Lake Rec. Area, T21N,R13W,Sec 31***	**5**
MA6	**Dorner Lake CG, T21N,R13W,Sec 19***	**5**

*Sites were treated via the Michigan Cooperative Program.

Therefore, the treatment had some benefit. A "good" Bt application may kill 70-80 percent of the young caterpillars, however, that may not be sufficient to prevent some defoliation when dealing with populations exceeding 1000 egg masses per acre. This was the case for both Gizzard Chips and Timber Creek, where egg mass estimates in the fall of 1992 were 2000+ and 1307 per acre, respectively. Another concern is the relatively small treatment blocks that create the likelihood of reinvasion from heavily infested neighboring areas. No reliable information exists on minimum block size required to eliminate reinvasion of gypsy moth caterpillars from untreated adjacent areas.

1994 SITE EVALUATIONS

A total of 64 sites, including two orchards were surveyed for egg mass estimates in October and November 1993 (Tables 2 and 3). Not all of these sites were designated by Ranger Districts as potential treatment blocks, rather some were listed as areas for "monitoring only". The monitoring only blocks are ignored in the remainder of this document. **Of those sites designated as potential treatment areas, 29 locations exceeded the 300 egg masses per acre criteria (Table 4). These sites totalled 1638 acres. No orchard sites had egg mass estimates greater than three per tree, therefore, no treatment of any orchards is recommended.**

DISCUSSION

1993 PROGRAM EVALUATION

In order to document the success or failure of any 1994 project, a much better job of post-spray site evaluation (i.e. defoliation estimates) needs to be done on treated sites in 1994.

The Forest continues to have some modest amounts of defoliation, even on sites considered successfully treated. This should not be surprising, when treatments are limited to Bt. Bt simply is not that efficient of an insecticide compared to some of the other chemical based insecticides available.

No apparent problems have been noted with the sites treated within the Michigan Cooperative Suppression Program. Defoliation levels on the two sites sampled were very low, at five percent (Table 1).

The use of 20 BIU's per acre in 1993 versus 16 BIU's per acre in 1992 and 1991 cannot be evaluated in this operational project. Poor control on some sites with very heavy gypsy moth populations in 1991 and 1992 led to the recommendation for using the higher rate of 20 BIU's per acre in 1993. The Michigan Cooperative Program does utilize 16 BIU's and those sites should be available as a comparison to Forest sites using 20 BIU's/acre.

Unpredictable weather continues to be a variable that plays a major role in the gypsy moth situation on the Huron-Manistee Forest. A number of areas, especially in the Cadillac area, were predicted to have heavy defoliation in 1993. In many of those areas populations crashed. This was possibly a result of an unusually wet, cool summer that encouraged virus outbreaks. Unfortunately, nothing can be done to control or predict weather events.

EVALUATIONS OF SITES PROPOSED FOR TREATMENT IN 1994

The small egg mass sizes (nickel and dime) commonly reported on the Baldwin, Cadillac and White Cloud Districts indicate that gypsy moth populations in those areas may be peaking. It is likely that in 1994, there will be a number of localized virus outbreaks causing natural population collapses. Unfortunately, this is likely to be spotty in nature. We do not have the ability to tell what sites will collapse and what sites will not. Therefore, any high value sites on those Districts, listed in Table 4, should be considered for treatment to guarantee damaging gypsy moth caterpillar populations do not exist in 1994. The one exception is the Spare Change Timber Sale site on the Baldwin District, B25. This is a timber sale that has not been treated in previous years. It had an egg masses per acre estimate of 480, high enough to be considered for treatment. However, that number is not excessive. Further, the normal egg mass size is dime and nickel, indicating a relatively unhealthy gypsy moth population. The ratio of new to old egg masses is in the neighborhood of 4:6. This again indicates a possible declining gypsy moth situation. If defoliation does occur in 1994, treatment could protect the trees in 1995 and tree mortality would still be unlikely.

As a general rule-of-thumb, recent oak thinnings should be protected from defoliation for two years. After that time period, the trees should have recovered sufficiently from the short-term thinning stress to the point where they can withstand some defoliation and still survive. The Gizzard Chips site, on the Baldwin District, B22 in Table 4, was protected in 1993. Protection should be considered again in 1994 as 40-45 percent defoliation occurred in that area, even with a Bt application in 1993.

The Manistee District, compared to other Districts further east, is still in the early stages of gypsy moth infestation. Egg mass sizes on the Manistee District were reported as quarter size. Both the age of the infestation and the large egg masses indicate that defoliating populations are very likely on this District.

On the Manistee Ranger District, site MA4, Lake Michigan Recreation Area, appears to be in close proximity to Lake Michigan and possibly close to dune habitats. Recently, in Wisconsin, the dune habitats have been identified as areas with rare or threatened lepidopteran species present. The possibility exists that one or more of these species could be present as feeding larvae at the time of Bt application. Efforts should be made to identify if these habitats exist within the proposed treatment block.

Gypsy moth populations appear to be rebounding on the Huron Forest. Egg mass sizes were reported to be quarter size on the Mio and Tawas Ranger District sites. A great deal of oak still exists on those Districts and as long as a preferred food source is present, large gypsy moth populations will occasionally occur into the forseable future.

Treatment Options

Five management options are discussed for sites with greater than 300 egg masses per acre and orchards with greater than 3 egg masses per tree. These options are based upon the following objectives: 1) protecting host tree foliage; 2) preventing tree mortality; and 3) reducing gypsy moth populations.

Option 1: No Action

If caterpillar populations do occur as predicted, defoliation of trees is likely to occur in the areas listed in Table 4. Oak, aspen, birch, basswood and apple are likely to sustain the greatest amount of leaf loss. Small understory white pine and hemlock also could be defoliated if growing under an oak or aspen overstory. In addition, defoliation in recreation sites may result in branch or tree mortality that could lead to an increased number of hazard trees. High caterpillar numbers can create a nuisance problem for recreation site users. Since gypsy moths are notorious for pupating and egg laying on vehicles and camping equipment, their presence at recreation sites creates increased opportunities for inadvertent long distance spread.

Trees growing under less than optimum conditions are more likely to die or have branches die if defoliated. These conditions include: 1) soil compaction, such as in campgrounds, and near parking areas; 2) over-mature stands; 3) drought-stressed stands; 4) recently partially harvested stands; and, 5) areas previously defoliated.

Due to weather events or possible disease epizootics, gypsy moth populations could collapse on some or all sites on the Huron-Manistee. In 1994, evidence of smaller egg masses has been observed on the Forest. Small egg masses, nickel or dime size, are often an indication of a declining and stressed gypsy moth population. These populations are more likely to collapse naturally than populations with large egg masses of quarter size. Many populations on the Baldwin, Cadillac and White Cloud Districts are likely to have localized population crashes in 1994, whereas, it appears probable that relatively healthy, high populations will occur on the Manistee, Mio and Tawas Districts. Unless widespread viral outbreaks occur, this option does not meet objectives 1, 2 or 3.

Option 2: Aerial Application of a Chemical Insecticide

Aerial application of chemical insecticides may be used to suppress gypsy moth populations. Several chemical insecticides are registered by EPA for control of gypsy moth in the U.S., but only Dimilin is used widely in aerial treatment programs because of environmental and political reasons. Dimilin (diflubenzuron) is an insect growth regulator that disrupts the normal molting process of immature insects. The mode of action is to inhibit the formation of chitin, a necessary component of the insect cuticle, which causes the affected insect to die during the molting process. The primary mode of uptake is by ingestion, though some uptake through cuticular absorption may occur.

Dimilin is toxic to aquatic invertebrates and should not be applied to open water or wetland environments. Dimilin will kill other insects on treatment sites if those insects are in a susceptible life stage (immature stage) and ingest or absorb it. Dimilin is available as a 25 percent wettable powder

formulation (25W) and as a 4 lb per gallon liquid formulation (4L). The recommended application rate is 0.5-2.0 ounces of formulated product per acre applied in one treatment. If properly applied, foliage protection and population reduction of about 95 percent may be expected. Dimilin has a better record than Bt for protecting foliage and reducing gypsy moth caterpillar numbers on sites with very high egg mass counts (i.e. > 2000/acre).

This option will meet objectives 1 and 2. It will also meet objective 3 on the site treated. The overall local population outside of the treatment block may not be reduced, and depending on treatment block size, adjacent populations may readily reinfest the treated area. However, Dimilin has a much longer residual activity period (60 days) than Bt and, therefore, should prevent reinfestation by larvae.

Option 3: Aerial Application of a Microbial Insecticide

Currently, the only biological insecticide readily available is Bacillus thuringiensis variety kurstaki (Bt). Bt is available through a variety of manufacturers. It is registered by EPA for gypsy moth control and has been used extensively in the Northeastern U.S. and in the Lake States. This variety of Bt acts specifically on lepidopterous larvae as a stomach poison and, therefore, must be ingested. The major mode of action is by mid-gut paralysis, which occurs 3-5 days after ingestion.

Bt formulations are available as flowable concentrates, wettable powders and emulsifiable suspensions. A "neat" application of undiluted product may be applied. Labeled rates vary. Rates normally applied have been 16 BIU's per acre, though higher rates are available on various labels.

The other application method available would be 3/4-1 gallon total mix per acre which commonly includes a spreader/sticker additive at the rate of two percent by volume. For this, normal application rates range from 16-20 BIU's per acre in a single application or two applications of 12-16 BIU's each, 7-10 days apart.

With proper application of either method, population reductions of about 70-80 percent can be expected. When very high caterpillar populations occur (>1000 egg masses/acre), 70-80 percent population reduction may not be enough to reduce defoliation levels below 30 percent. The use of a higher BIU/acre rate (i.e. 24 BIU's) should reduce caterpillar populations more significantly than 16 BIU's per acre has in the past.

This option, in most cases, will meet objectives 1 and 2. If caterpillar populations are very high, visible defoliation may occur even if proper application of Bt is accomplished. Therefore, this option will likely meet objective 3 by reducing gypsy moth populations on the treatment site, but that reduction may not be great enough for the project to be deemed successful. Further, the overall local population, outside the treatment block, may not be reduced and depending on treatment block size, adjacent populations may readily reinfest the treated area the next year.

Option 4: Control by Hand Picking (Orchards Only)

This option is not viable in forest stands where trees are large and egg masses may number in the thousands per acre. However, in certain situations, such as small orchard settings, hand removal of egg masses may reduce local populations enough to reduce foliage loss and protect tree vigor, especially if egg mass counts are not extremely high (1-3/tree). Egg mass removal could be done at any time following the egg laying period up until egg hatch in early spring. Egg masses must be collected and destroyed, not merely knocked to the ground. This option would be time consuming on a per acre basis, but considering the small size of some orchards, it may be viable. From a wildlife standpoint, this option is highly attractive since it would result in no mortality to other species of caterpillars on orchard trees, thus maintaining a non-gypsy moth caterpillar food source for songbirds.

Under the appropriate circumstances, this option would meet objectives 1, 2 and 3. Surrounding stands would be a concern for reinfestation if they contained high egg mass densities and/or contain high percentages of susceptible host type.

Option 5: Backpack Spraying of Bt (Orchards Only)

This option is only viable for small areas with low growing trees, such as an orchard. Bt could be applied using backpack spray equipment. This option should be considered if egg mass populations are deemed too great for the hand removal option or if egg masses are present in the upper-half of orchard trees making hand removal difficult. This option may be preferable to aerial spraying because the Bt would only be applied to tree foliage. Therefore, only caterpillars present in trees would be impacted.

Under the appropriate circumstances, this option would meet objectives 1 and 2. Surrounding stands, if they contain high egg mass densities and/or contain high percentages of susceptible host type, would be a concern for reinfestation. Therefore, objective 3 may or may not be met.

ALTERNATIVES

With the previously described options in mind, the following alternatives have been developed:

Forest Stands

Alternative 1. -- No action.

Alternative 2. -- A single aerial application of Dimilin. Mix 2 ounces of Dimilin 25W with enough water to apply 1 gallon total volume per acre. Though the label allows higher application rates we do not recommend exceeding 2 ounces of Dimilin 25W per acre.

Alternative 3. -- A single aerial application of Bt applied at a rate of 16 BIUs/acre in 3/4-1 gallon water per acre total mix with an appropriate spreader/sticker added at the rate of 2 percent by volume.

Alternative 4. -- A single "neat" aerial application of Bt applied at a rate of 16 BIU's/acre.

Alternative 5. -- A single "neat" aerial application of Bt applied at a rate of 20-24 BIU's/acre.

Alternative 6. -- Two "neat" aerial applications of 16 BIU's/acre applied 7-10 days apart.

Alternative 7. -- A single "neat" aerial application of Bt applied at a rate of from 16 BIU's/acre adjacent to aquatic areas and a single aerial application of Dimilin 25W in areas not adjacent to water. Mix 2 ounces of Dimilin 25W with enough water to apply 1 gallon total volume per acre.

Orchards

Alternative 1A -- No action.

Alternative 2A -- Hand removal and destruction of egg masses from orchard trees.

Alternative 3A -- Backpack spray small orchards with Bt. Apply a single application at 16 BIUs per acre and spray to the point of runoff. Mix the proper amount of Bt with 10 gallons of water and add an appropriate spreader/sticker.

Alternative 4A -- Treat orchards in the same manner as general spray blocks and apply alternatives 2-7 listed above.

RECOMMENDATIONS

We recommend alternative 4 or 5, where aerial treatment is considered. Bt use has fewer environmental concerns than Dimilin (Alt. #2). Serious consideration should be given to continuing the BIU/acre rate at 20-24 (Alt. 5). Our results for foliage protection were not sterling in 1991 and 1992, and one problem identified was that the rate of 16 BIU's per acre used in 1991 and 1992 was not enough to suppress the very high caterpillar populations present.

Any treatment sites adjacent to open water or wetlands should not have the Dimilin alternative (# 2) considered.

On recreation sites listed in Table 4, insecticide application (alt. 2 through 7) will be required to prevent nuisance caterpillar populations in 1994. This treatment should also reduce tree or branch mortality at recreation sites by reducing defoliation levels.

Recreation and heavy visitor use sites should continue to be a high priority for protection. Reducing gypsy moth populations on these sites will decrease visitor complaints and should improve the "quality" of the visit. Also, control on these sites should reduce the number of hazard trees created by gypsy moth defoliation. An important aside to protecting these sites may be reducing the likelihood of long distance spread. This would seem likely because fewer caterpillars on a site reduces the likelihood of pupation or egg laying occurring on a recreational vehicle or associated camping equipment and subsequent transportation to uninfested areas.

We suggest the Forest continue to participate, where possible, within the Michigan Cooperative Suppression Program. This is especially beneficial for sites located on the periphery of the Forests or for small treatment areas. This program does have Forest Service oversight (State and Private Forestry). The proposed sites on the Manistee Ranger District would seem to be likely candidates for participation in that program. Those sites are located a long distance from the Cadillac airport and might be more easily treated within the Manistee County program.

The Driftwood Campground site (MA 8) on the Manistee District is listed as only 8 acres. Aerial treatment is often difficult on such small blocks. If the forest type is conducive to gypsy moth defoliation, consider making the block somewhat larger.

Field survey the Lake Michigan Recreation Area site on the Manistee District. Be aware of any sensitive habitats, especially dune habitats. These may harbor rare lepidopteran species. If necessary, modify treatment blocks to avoid those habitats.

A more thorough post-treatment evaluation of spray sites must be done. We suggest a formal request to FHP in St. Paul for their staff to conduct this evaluation. A formal request would place the post-treatment evaluation on the annual work plan developed by FHP.

Training should be conducted in the fall of 1994 to make sure the egg mass survey crews can differentiate new from old egg masses. This can be

difficult. As gypsy moth populations build across the entire Huron-Manistee the ability to count only new egg masses will be necessary to obtain reliable data for future evaluations.

Be aware of the Karner Blue butterfly and its habitat requirements. This federally endangered species is very likely to be impacted negatively by a direct application of Bt during the gypsy moth treatment period (mid-May through early June).

Table 2. Sites surveyed for egg masses, excluding orchards, acreage of each site and estimated egg masses per acre. Egg mass estimates determined using 1/40th acre fixed-radius plots. Sites surveyed during October and November 1993. Site numbers correspond to the attached maps. Each site is listed by local name (CG indicates campground, CL indicates canoe landing, OSA indicates oak study area, TS indicates timber sale) and legal description. Sites with (NA) in the data columns were not sampled in 1993, but were sampled in 1992. For orchards see Table 3.

SITE #	AREA NAME (LEGAL DESCRIPTION)	ACREAGE (ACRES)	EGG MASSES PER ACRE	EGG MASS SIZE
	BALDWIN DISTRICT			
B1	Peacock OSA, T19N,R14W,Sec 13	20	1320+	nickel
B2	US 10 OSA, T18N,R13W,Sec 16	20	640	nickel
B3	US 10 E. Rest Area, T17N,R11W,Sec 1	20	680	nickel
B4	Highbank CG, T16N,R13W,Sec 17,20	40	800+	dime
B5	Old Grade CG, T19N,R13W,Sec 10	140	1040+	nickel
B6	County Line OSA, T16N,R14W,Sec 5	20	480	nickel
B7	Green Cottage CL, T17N,R13W,Sec 16	40	80	quarter
B8	Bowman Bridge CG, T17N,R14W,Sec 2	40	1600+	nickel
B9	Indian Bridge CL, T18N,R16W,Sec 23	20	0	NA
B10	Elk Canoe CG, T18N,R14W,Sec 30	20	1880+	nickel
B11	Nichol's Lake, T16N,R13W,Sec 31	41	1680+	nickel
B12	Walkup Lake CG, T16N,R13W,Sec 31	41	1560+	nickel
B13	Weary TS, T19N,R13W,Sec 17-20	200	NA	NA
B14	Claybank's OSA, T17N,R13W,Sec 8	20	320	nickel
B15	Upper Branch CL, T18N,R14W,Sec 30	20	1680+	nickel
B16	Rainbow Rapids, T18N,R14W,Sec 27,28	58	1800+	nickel
B17	Timber Creek CG, T18N,R14W,Sec 16	35	760	dime
B18	US 10 W. Rest Area, T18N,R14W,Sec 13	20	NA	NA
B19	Maple Leaf CL, T17N,R15W,Sec 23	40	1080	quarter
B20	Lower Branch CL, T17N,R15W,Sec 24	26	1160	nickel
B21	Cold Deck TS, T19N,R13W, Sec 19	180	NA	NA
B22	Gizzard Chips TS, T18N,R14W,Sec 15	274	1000+	nickel
B23	Gleason's CL, T17N,R14W,Sec 13	20	840	nickel
B24	Bridle Chain TS, T18N,R14W,Sec 9	260	280	dime
B25	Spare Change TS, T18N,R14W,Sec 8,9	120	480	nickel
District Total		1735		
	CADILLAC DISTRICT			
C1	Stod. Lake, T23N,R10W,Sec 24,25,36			
	Block 14 Sec 24	20	NA	NA
	Block 15 Sec 25	25	320	nickel
	Block 16 Sec 36	21	440	nickel
C2	N. Waggonwheel, T22N,R12W,Sec 33,34	417	NA	NA
C3	Saddler Rd. Oaks, T20N,R11W,Sec 21	21	NA	NA
C4	WPBN Tower Oaks, T22N,R12W,Sec 24	185	640	nickel
C5	88 Oaks, T21N,R11W,Sec 17-20	712	NA	NA
C6	Dowling Creek, T21N,R11W,Sec 29	100	240	nickel
C7	Ravine CG, T21N,R11W,Sec 28	20	160	nickel

Table 2 continued on next page.

Table 2 continued.

SITE #	AREA NAME (LEGAL DESCRIPTION)	ACREAGE (ACRES)	EGG MASSES PER ACRE	EGG MASS SIZE
C8	Elm Flats CL, T20N,R12W,Sec 2	20	NA	NA
C9	Wellston Lab, T21N,R12W,Sec 7	22	1320	nickel
C10	Peterson South, T21N,R12W,Sec 20	24	840	nickel
C11	Dobson Bridge CL, T21N,R12W,Sec 27,28	20	120	nickel
C12	Mission Ch., T22N,R12W,Sec 29,32	125	80	nickel
C13	N.Research Colfax, T23N,R10W,Sec 35	10	NA	NA
C14	Cooley & Low Bridge, T21N,R13W,Sec 16	120	2400+	quarter
District Total		1862		
	MANISTEE DISTRICT			
MA1	Bindle Stiff TS, T22N,R13W,Sec 4	40	240	quarter
MA2	Red Bridge Rec Area, T22N,R13W,Sec 22	4	NA	NA
MA3	Blacksmith Bayou, T22N,R14W,Sec 32	20	NA	NA
MA4	Lake Mich. Rec Area, T20N,R18W,Sec 23	150	920	quarter
MA5	Sand Lake CG, T20N,R13W,Sec 31	20	40	quarter
MA6	Dorner Lake CG, T21N,R13W,Sec 19	8	280	quarter
MA7	Pine Lake CG, T21N,R14W,Sec 28	10	80	dime
MA8	Driftwood Valley CG, T20N,R14W,Sec 16	8	360	quarter
MA9	Beartrack CG, T20N,R14W,Sec 6	5	160	quarter
MA10	Hoags Lake Rec Area, T20N,R16W,Sec 11	20	NA	NA
MA11	Udell Hills, T21N,R15W,Sec 24	20	240	nickel
MA12	Udell Tower, T21N,R15W,Sec 23	20	440+	nickel
MA13	Udell Rollways CG, T22N,R15W,Sec 36	10	1200	quarter
MA14	Wellston Station,T21N,R13W,Sec 7	10	NA	NA
MA15	Chittendon Nursery, T21N,R14W,Sec 18	20	40	quarter
District Total		365		
	WHITE CLOUD DISTRICT			
W1	Hungerford Lake, T15N,R11W,Sec 15	40	1600+	nickel
W2	Nichols Lake CG, T15N,R13W,Sec 6	73	320	nickel
W3	WC Ranger Station, T14N,R12W,Sec 12	10	NA	NA
W4	Loda Lake Picnic, T14N,R13W,Sec 2	35	NA	NA
W5	Benton Lake CG, T15N,R13W,Sec 20,29	72	200	dime
W6	Pines Point CG, T13N,R15W,Sec 8,9	40	0	-----
W7	Fry Lake OSA, T13N,R12W,Sec 23	5	NA	NA
W8	Petit Lake OSA, T12N,R12W,Sec 25	5	NA	NA
W9	Brooks Lake OSA, T12N,R12W,Sec 34	20	0	-----
W10	Harness Marsh OSA, T13N,R11W,Sec 7	5	NA	NA
W11	Oxford OSA, T15N,R12W,Sec 21	5	NA	NA
W12	Winston Rd OSA, T13N,R15W,Sec 19,20	20	0	-----
W13	Indian Lake OSA, T15N,R13W,Sec 26	20	320	quarter
W14	East Side TS#1, T14N,R11W,Sec 1	80	NA	NA
W15	East Side TS#2, T14N,R11W,Sec 10	130	NA	NA
W16	Gusher TS, T14N, R11W, Sec 23	74	280	nickel
W17	Pines Point OSA, T13N,R15W,Sec 5	20	0	------
W18	Baseline TS, T14N,R13W,Sec 35,36 T13N,R12W,Sec 6	91	240	nickel
District Total		745		

Table 2 continued on next page.

Table 2. continued.

SITE #	AREA NAME (LEGAL DESCRIPTION)	ACREAGE (ACRES)	EGG MASSES PER ACRE	EGG MASS SIZE
	MIO DISTRICT			
MI1	Island Lake CG, T25N,R2E,Sec 36	24	80	quarter
MI2	Luzerne Trail Camp, T25N,R1E,Sec 2	36	400	quarter
MI3	Kneff Lake CG, T26N,R2W,Sec 20	??	280	nickel
District Total		XX		
	TAWAS DISTRICT			
T1	So. Branch Trail Camp, T24N,R5E,Sec 11	57	960	quarter
T2	Rollways CG, T24N,R5E,Sec 24	103	80	quarter
T3	SidTown, T24N,R7E,Sec 20	56	320	nickel
T4	Lumberman's Mon., T24N,R7E,Sec 31,32	45	1560	quarter
T5	Iargo Springs, T24N,R6E,Sec 26	19	920	quarter
T6	Round Lake CG, T22N,R6E,Sec 3	43	600	quarter
T7	Sand Lake Picnic Area, T23N,R6E,Sec 36	2	40	quarter
District Total		325		
Forest Total		XXXX		

Table 3. Orchard sites surveyed for egg masses, acreage of each site, estimated egg masses per tree and egg mass size. Sites surveyed during October and November 1993. Each site is listed by a common name or by Forest Service compartment (C) and stand number (S), and legal description. Sites with (NA) in the data columns were not sampled in 1993, but were sampled in 1992.

SITE #	ORCHARD NAME (LEGAL DESCRIPTION)	ACREAGE (ACRES)	EGG MASSES PER TREE	EGG MASS SIZE
	CADILLAC DISTRICT			
OR1	Powerline,T21N,R12W,Sec 10	1	NA	NA
OR2	Peterson Cr.,T21N,R12W,Sec 9	1	NA	NA
OR3	McKenzie Ski Trail,T21N,R12W,Sec 2	2	NA	NA
OR4	Caberfae,T21N,R11W,Sec 6	10	0	-----
OR5	Lost Pines Lodge,T21N,R11W,Sec 4	6	NA	NA
OR6	C143 S22,T22N,R10W,Sec 4	1	NA	NA
OR7	C 94 S98, T21N,R11W,Sec 22	4	< 1	nickel
OR8	C 68 S9, T22N,R11W,Sec 6	5	NA	NA
OR9	C 68 S6, T22N,R11W,Sec 6	2	NA	NA
OR10	C 69 S19, T22N,R11W,Sec 6	1	NA	NA
District Totals		33		
	WHITE CLOUD DISTRICT			
OR11	Apple Orchard, T15N,R12W,Sec 23	3	NA	NA
OR12	Apple Orchard, T14N,R12W,Sec 16	5	NA	NA
District Totals		8		
Forest Totals		41		

Table 4. Sites sampled for egg masses which have egg mass estimates exceeding a predicted damage threshold of 300/acre for forested sites and 3/tree for apple orchards. Egg mass surveys were conducted in October and November 1993. Site numbers correspond to Table 2 and the attached maps, (CG indicates campground, CL indicates canoe landing, TS indicates timber sale). **Only sites listed as possible treatment areas by the Districts are listed in this table.**

SITE #	AREA NAME (LEGAL DESCRIPTION)	ACREAGE (ACRES)	EGG MASSES PER ACRE	EGG MASS SIZE
	BALDWIN DISTRICT			
B3	US 10 E. Rest Area, T17N,R11W,Sec 1	20	680	nickel
B4	Highbank CG, T16N,R13W,Sec 17,20	40	800+	dime
B5	Old Grade CG, T19N,R13W,Sec 10	140	1040+	nickel
B8	Bowman Bridge CG, T17N,R14W,Sec 2	40	1600+	nickel
B10	Elk Canoe CG, T18N,R14W,Sec 30	20	1880+	nickel
B11	Nichol's Lake, T16N,R13W,Sec 31	41	1680+	nickel
B12	Walkup Lake CG, T16N,R13W,Sec 31	41	1560+	nickel
B15	Upper Branch CL, T18N,R14W,Sec 30	20	1680+	nickel
B16	Rainbow Rapids CL, T18N,R14W,Sec 27,28	58	1800+	nickel
B17	Timber Creek CG, T18N,R14W,Sec 16	35	760	dime
B19	Maple Leaf CL, T17N,R15W,Sec 23	40	1080	quarter
B20	Lower Branch CL, T17N,R15W,Sec 24	26	1160	nickel
B22	Gizzard Chips TS, T18N,R14W,Sec 15	274	1000+	nickel
B23	Gleason's CL, T17N,R14W,Sec 13	20	840	nickel
B25	Spare Change TS, T18N,R14W,Sec 8,9	120	480	nickel
District Total		935		
	CADILLAC DISTRICT			
C9	Wellston Lab, T21N,R12W,Sec 7	22	1320	nickel
C10	Peterson South, T21N,R12W,Sec 20	24	840	nickel
C14	Cooley & Low Bridge, T21N,R13W,Sec 16	120	2400+	quarter
District Total		166		
	MANISTEE DISTRICT			
MA4	Lake Mich. Rec Area, T20N,R18W,Sec 23	150	920	quarter
MA8	Driftwood Valley CG, T20N,R14W,Sec 16	8	360	quarter
MA13	Udell Rollways CG, T22N,R15W,Sec 36	10	1200	quarter
District Total		168		
	WHITE CLOUD DISTRICT			
W1	Hungerford Lake, T15N,R11W,Sec 15	40	1600+	nickel
W2	Nichols Lake CG, T15N,R13W,Sec 6	73	320	nickel
District Total		113		

Table 4 continued on next page.

Table 4 continued.

SITE #	AREA NAME (LEGAL DESCRIPTION)	ACREAGE (ACRES)	EGG MASSES PER ACRE	EGG MASS SIZE
	MIO DISTRICT			
MI2	Luzerne Trail Camp, T25N,R1E,Sec 2	36	400	quarter
District Total		36		
	TAWAS DISTRICT			
T1	So. Branch Trail Camp, T24N,R5E,Sec 11	57	960	quarter
T3	SidTown, T24N,R7E,Sec 20	56	320	nickel
T4	Lumberman's Mon., T24N,R7E,Sec 31,32	45	1560	quarter
T5	Iargo Springs, T24N,R6E,Sec 26	19	920	quarter
T6	Round Lake CG, T22N,R6E,Sec 3	43	600	quarter
District Total		220		
Forest Total		1638		